

The Dicamba Conundrum



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Xtend Crop Launch

- ❖ Full commercialization of Xtend Technologies
 - Dicamba resistant soybeans and cotton
- ❖ Approved dicamba products for Xtend Crops
 - Xtendimax, Fexapan, Engenia
 - Lower volatility than Banvel and Clarity
- ❖ Confusing Labelling
 - Federal label, Supplemental labels, Label websites
 - Very specific application guidelines to minimize off-target movement

Xtend Crop Launch

- ❖ Good efficacy if utilized as part of a program and applied in a timely manner
- ❖ Too much off-target movement to non-target crops and plants
 - Sources and causes
 - Impact on yields?
 - Updated labels for 2018
 - Will it be different in 2018?



RR2 Xtend Soybeans



Fierce XLT (PRE) fb Roundup PM + Dicamba (P)



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RR2 Xtend Soybeans



Roundup PowerMax + Dicamba (P)



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Two-Pass vs One-Pass Dicamba



RR2 Xtend Soybeans



Envive+Glyphosate+Dicamba (PP) fb Glyphosate+Dicamba (P)

Non-Xtend vs Xtend Soybeans



Field-Wide Injury from Dicamba

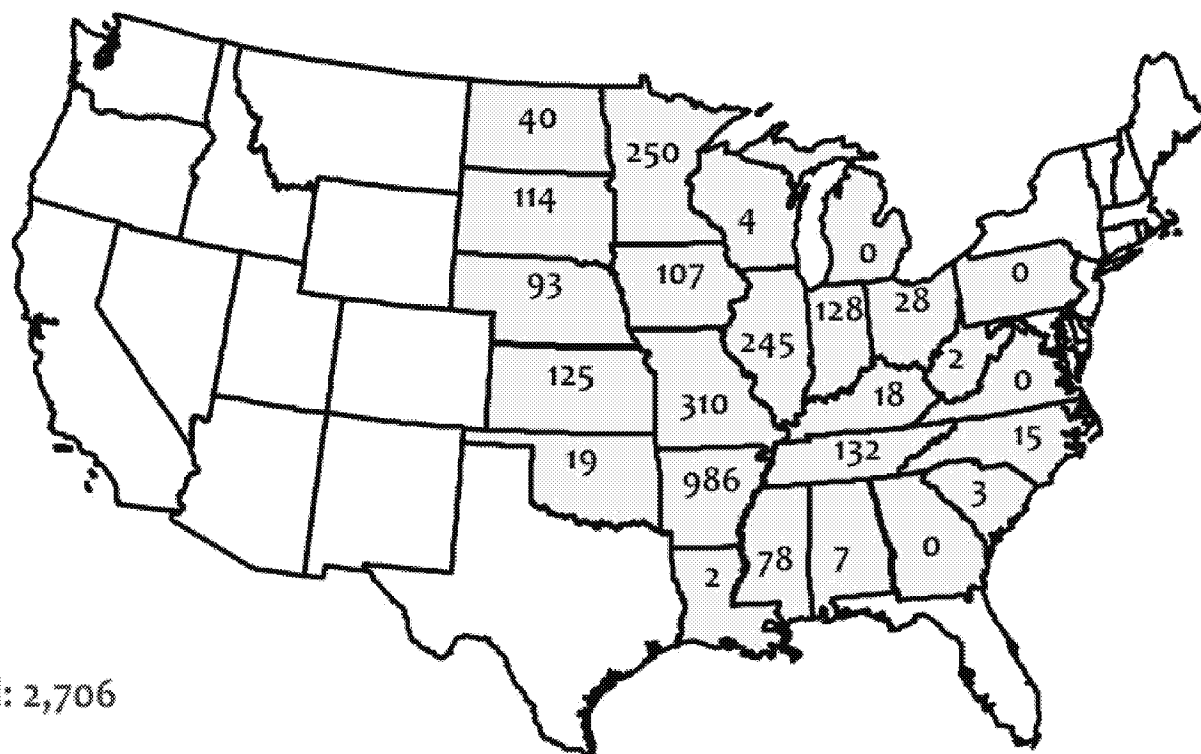


Non-Xtend Soybeans among Xtend Soybeans

No dicamba applied to plot area



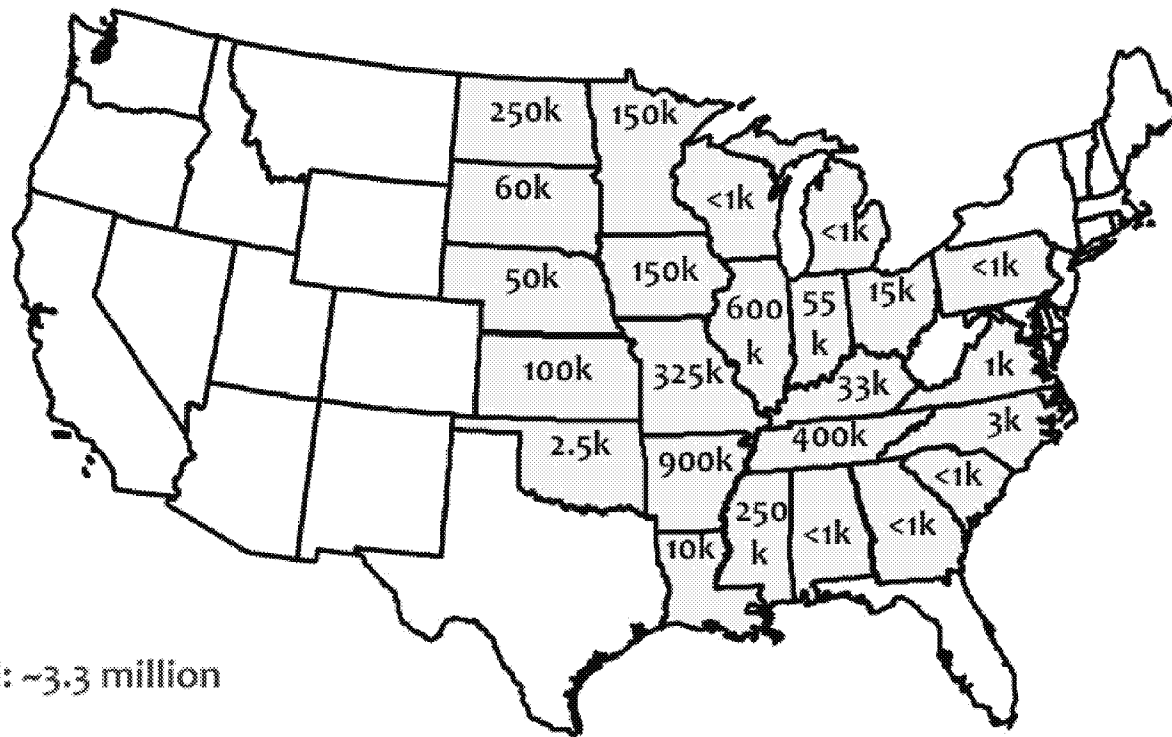
Official Dicamba-related Injury Investigations as Reported by State Departments of Agriculture (*as of October 15, 2017)



*Total: 2,706

©Dr. Kevin Bradley, University of Missouri

Estimates of Dicamba-injured Soybean Acreage in the U.S. as Reported by State Extension Weed Scientists (*as of October 15, 2017)



*Total: ~3.3 million

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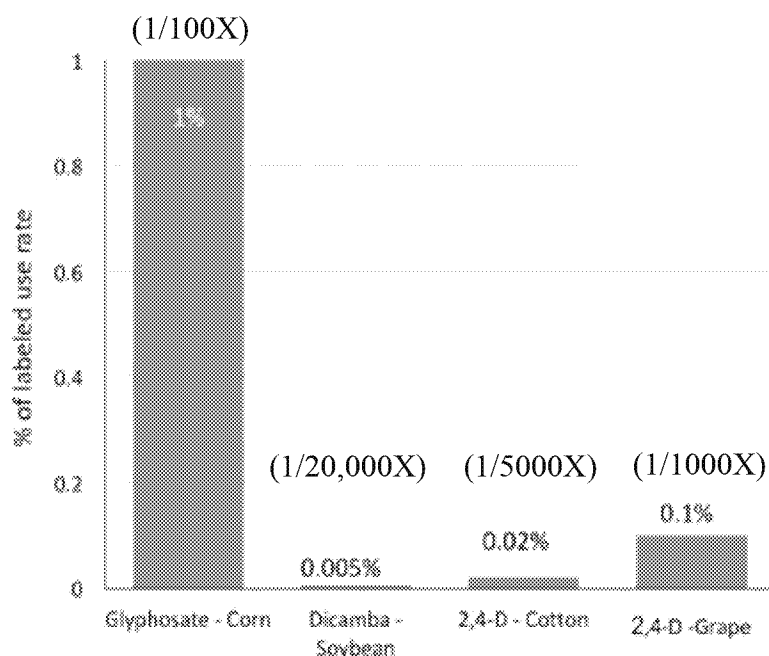
Severity for Off-Target Herbicide Injury

- ❖ Herbicide dose
- ❖ Plant susceptibility
- ❖ Plant growth stage
- ❖ Growing conditions

Non-Xtend Soybean Susceptibility to Dicamba

Compiled by Bob Hartzler, Iowa State University

Figure 1. Lowest observed dose causing significant visual crop response.



Soybean were 200 times more sensitive to dicamba as corn was to glyphosate, whereas cotton and soybean were at least 10 times more susceptible. Some people think the risk for off-target movement of dicamba is largely due to volatilization, and that the new formulations will minimize/eliminate those problems. The high sensitivity of soybean to dicamba makes them prone to injury, whether the exposure is due to vapor drift, particle drift or sprayer contamination. A new level of stewardship will be required to minimize problems caused by the large increase in use of dicamba and 2,4-D associated with the new herbicide resistant traits.

Below are the results from a simulated drift study conducted by K-State a few years back. Dicamba was applied to soybeans in the V2 to V3 growth stage at rates equal to 1/100, 1/33, 1/10, and 1/3 of the standard rate of 0.5 lb of dicamba per acre.

Fraction of dicamba rate	% Visual injury 7 Days after Treatment	% Visual Injury 30 Days after Treatment	% Height Reduction 30 days after Treatment	% Soybean Yield Loss
1/100	18	35	15	2
1/33	23	50	27	10
1/10	33	70	50	45
1/3	70	95	63	80

Dicamba injury to LL soybeans in adjacent plots



RR2X and LL program Comparisons



Zidua Pro PRE/
Engenia + Roundup Pmax POST

Authority First PRE/
Liberty POST

RR2X and LL program Comparisons

A black and white photograph of a large agricultural field, likely a soybean field, with rows of crops stretching towards the horizon. The sky is overcast with clouds. The image is used as a background for the title and treatment descriptions.

Zidua Pro PRE/
Engenia + Roundup Pmax POST

Authority First PRE/
Liberty POST

Weed control in different soybean systems at Manhattan, KS, 2017 (Peterson and Thompson).

Herbicide	Trait	Rate	Paam	Vele	Iimg	SB Yield
		(oz/a)	----(% control)----			(Bu/a)
Zidua Pro/Engenia+RUPMax	RR2X	6/12.8+32	100	100	98	58
Z Pro/Engenia+Zidua+RUPMax	RR2X	6/12.8+1.3+32	100	100	96	64
Sonic/Liberty	LL	5/29	99	100	98	60
Sonic/Liberty+Outlook	LL	5/29+10	99	100	97	61
Lsd (5%)			3	7	7	6

Planted and PRE 5/12, good PRE activation; Post 6/10, weeds < 2".

Diagnosing Source of Dicamba Injury

- ❖ Confounded by extreme susceptibility and delayed symptoms from low exposure rates
 - Only new growth exhibits cupping at very low rates
 - Cupping symptoms are similar over a wide range of low doses
 - Often not evident for at least one week after exposure
 - May not be observed for 3 weeks after exposure

Off-Target Herbicide Injury

- ❖ Particle spray drift with wind
- ❖ Vapor drift in the atmosphere following application
- ❖ Sprayer and handling equipment contamination
- ❖ Movement in runoff water
- ❖ Particle movement attached to dust particles

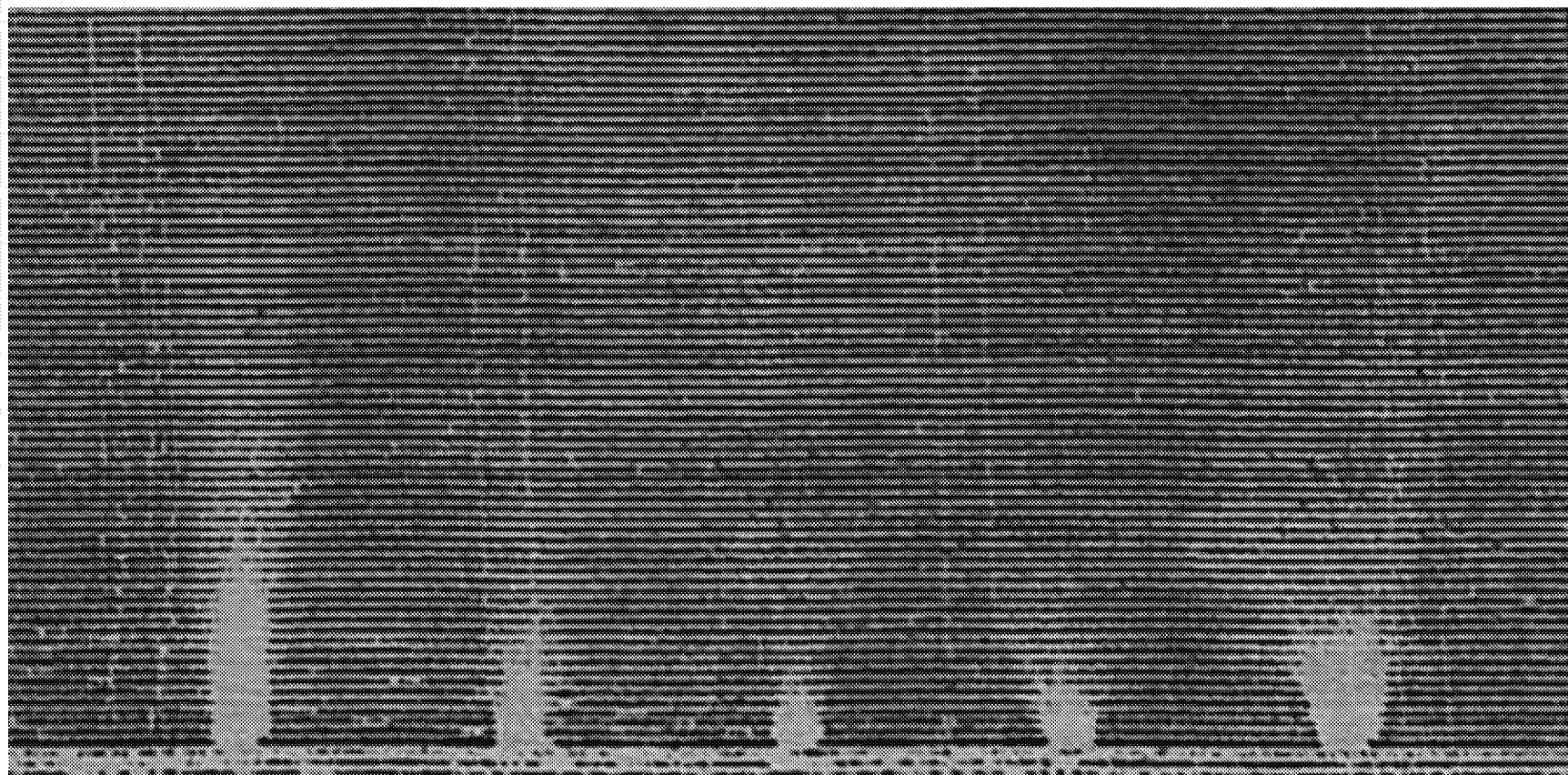
Factors Affecting Particle Spray Drift

- ❖ Proximity to application
- ❖ Wind speed and direction
- ❖ Spray droplet size
 - Spray nozzle tips
 - Spray pressure
- ❖ Boom height
- ❖ Humidity
- ❖ Temperature Inversions



Engenia Drift Demo

Treatments sprayed simultaneously with a 4 tip spray boom and 11004 spray tips for 10 secs at 40 psi held perpendicular to 12 mph wind



Dicamba injury 17 DAT	XR tips 24" boom ht	TDXL-D tips 24" boom ht	TTI tips 24" boom ht	ULD Tips 24" boom ht	ULD Tips 48" boom ht
Max Distance:	560 ft	255 ft	145 ft	230 ft	275 ft
Severe Injury:	50 ft	25 ft	15 ft	18 ft	30 ft

Factors Affecting Vapor Drift

- ❖ Volatility and stability of the pesticide
- ❖ Temperature
- ❖ Soil Moisture
- ❖ Humidity
- ❖ Spray target
- ❖ Wind speed and direction after application
- ❖ Temperature Inversions

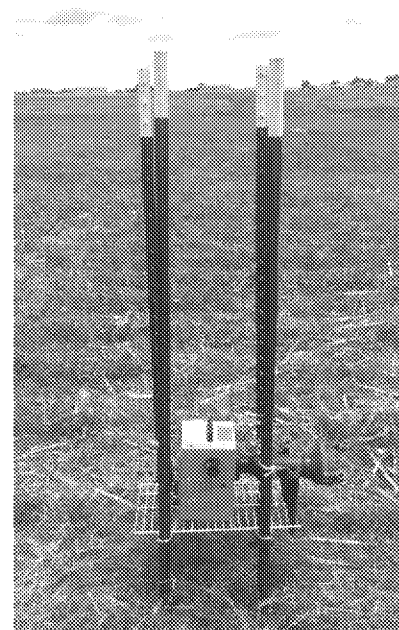
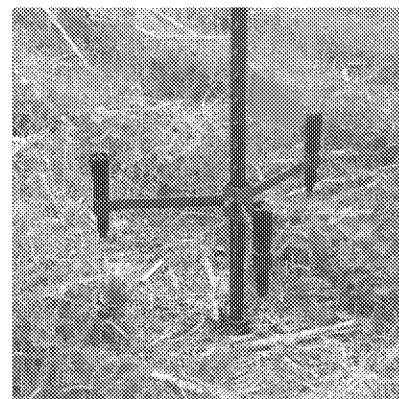
Vapor Drift Research in Missouri

Kevin Bradley, Univ of Missouri

Our Efforts to Understand the Role of Formulations & Temperature Inversions in the Off-site Movement of Dicamba

Methods:

- Banvel, Engenia, and Xtendimax sprayed in geographically separate areas.
- Air samples taken and indicator plants placed at regular intervals after treatment

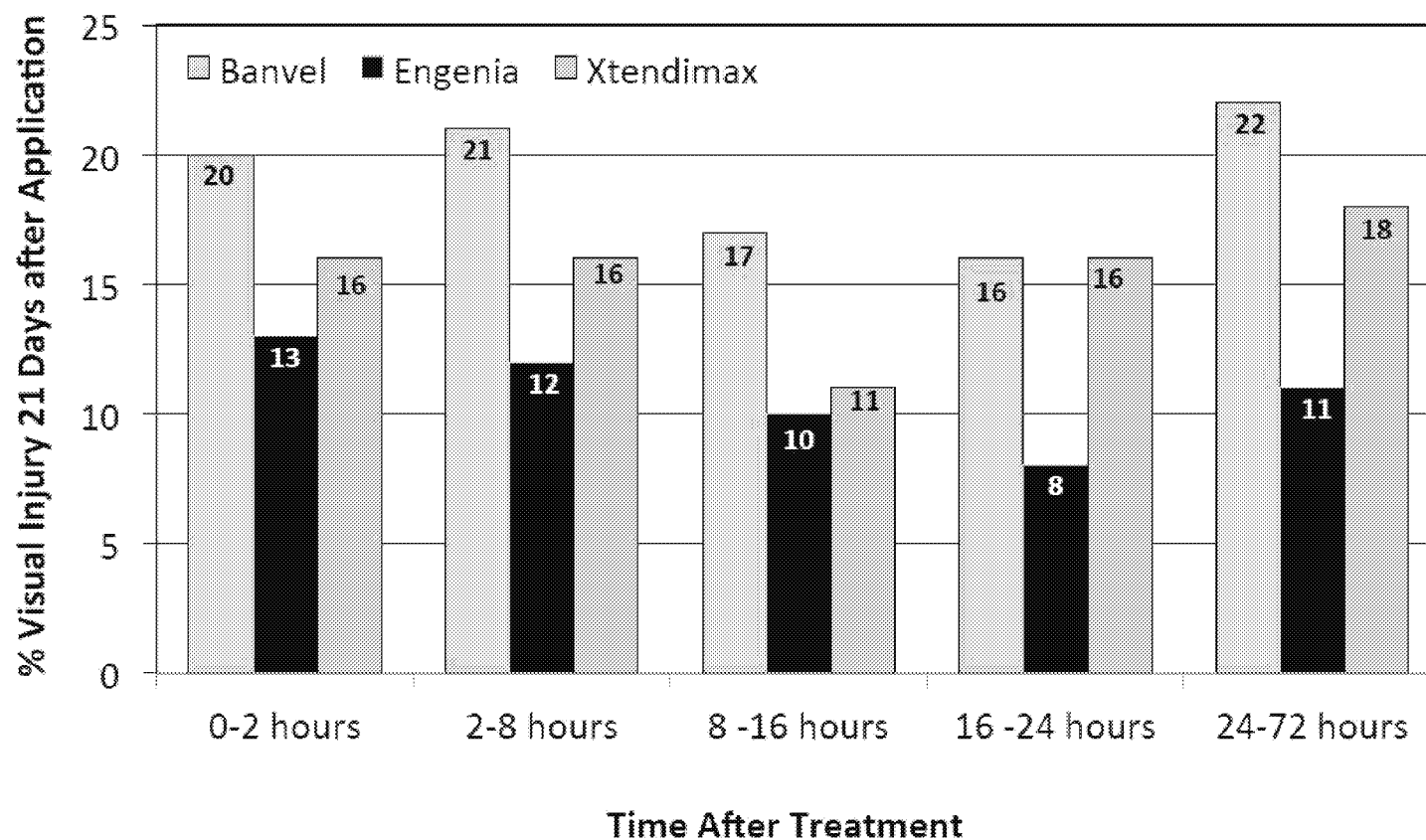


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Non-Xtend Soybean Response to Dicamba

Kevin Bradley, Univ. of Missouri

Evaluation of Soybean “Indicator Plant” Injury Following Application of 3 Dicamba Formulations

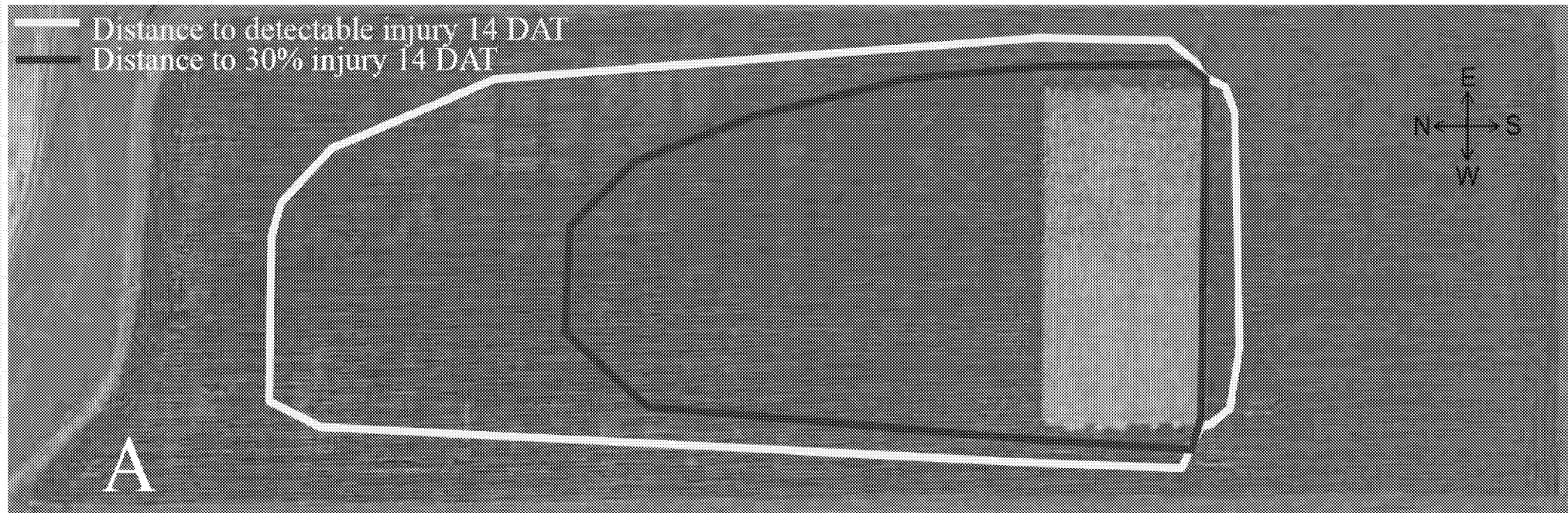


Particle Drift, Vapor Drift, Sprayer Contamination, or Temperature Inversions?

- ❖ Particle drift generally provides obvious pattern with injury most obvious adjacent to treated area in direction of wind.
- ❖ Sprayer or tender tank contamination generally uniform across field within a load.
- ❖ Boom contamination often in V patterns as boom empties out at the beginning of a load.
- ❖ Vapor drift fairly uniform, depending on air currents.
- ❖ Temperature inversions generally uniform, but possibly worse in lower areas – may facilitate enhanced particle and vapor drift.



Drift Pattern from 2012 Study



Dicamba + Roundup WeatherMax + Interlock sprayed at 10 gpa with TTI 11004 nozzles at 30 psi and south wind at 10 mph over the top of a 1 acre patch of 22 inch corn in the middle of a soybean field. Visible dicamba symptoms observed to a distance of 600 ft and 30% injury to a distance of 440 ft downwind. Injury also observed out to 30 ft on the upwind side despite south winds for 48 hr after application.

New Xtendimax, Fexapan, Engenia Label Changes

- ❖ Supplemental labels for use on Xtend crops will be combined into regular Federal label.
- ❖ Classified as Restricted Use Pesticides
 - Purchase and application by certified applicators only
- ❖ More specific record keeping on application, presence of susceptible crops, sprayer cleanout
- ❖ Applicators must complete dicamba or auxin-specific training prior to application

Xtendimax, Fexapan, Engenia Restrictions

- ❖ Do not apply when wind is blowing in the direction of neighboring susceptible crops, including non-DT soybean and cotton
- ❖ Spray only when wind is between 3 to 10 mph
- ❖ Do not spray during a temperature inversion
- ❖ Spray only between sunrise and sunset
- ❖ Do not apply with ammonium sulfate or any other ammonium containing products
- ❖ Do not apply if rain is expected within 24 hr

Xtendimax, Fexapan, Engenia

Application Restrictions

- ❖ The applicator must always maintain a 110 to 220 ft buffer from the downwind edge of field, less the distance of any areas below:
 - Roads, paved or gravel surfaces
 - Agricultural fields that have been prepared for planting
 - Planted agricultural fields containing asparagus, corn, DT cotton, DT soybeans, sorghum, proso millet, small grains and sugarcane
 - Areas covered by the footprint of a building, silo, or other man made structure with walls and or roof.



2017 Xtendimax Label Language

PROTECTION OF SENSITIVE AREAS

Maintain a 110 foot downwind buffer (when applying 22 fluid ounces of this product per acre) or a 220 foot downwind buffer (when applying 44 fluid ounces of this product per acre) between the last treated row and the closest downwind edge (in the direction in which the wind is blowing). If any of the following areas below are directly adjacent to the treated field, the areas listed below can be considered part of the buffer distance.

To maintain this required buffer zone:

- No application swath can be initiated in, or into an area that is within the applicable buffer distance.

The following areas may be included in the buffer distance calculation when adjacent to field edges:

- Roads, paved or gravel surfaces,
- Planted agricultural fields containing: corn, dicamba tolerant cotton, dicamba tolerant soybean, sorghum, proso millet, small grains and sugarcane. If the applicator intends to include such crops as dicamba tolerant cotton and/or dicamba tolerant soybeans in the buffer distance calculation, the applicator must confirm the crops are in fact dicamba tolerant and not conventional cotton and/or soybeans.
- Agricultural fields that have been prepared for planting.
- Areas covered by the footprint of a building, silo, or other man made structure with walls and or roof.

Xtendimax, Fexapan, Engenia

Application Restrictions

- ❖ Thoroughly clean sprayer before and after application and document
- ❖ May use an approved buffering agent if tank-mix components decrease spray solution < pH 5
- ❖ Do not apply aerially
- ❖ Consult associated product websites for approved spray tips, pressures, and tank-mix combinations

Xtendimax, Fexapan and Engenia e-label websites for latest updates

- ❖ www.xtendimaxapplicationrequirements.com
- ❖ www.fexapanapplicationrequirements.dupont.com
- ❖ www.engeniatankmix.com

Temperature Inversions

- ❖ Occur when temperatures at the soil surface are cooler than the air above and you no longer get a natural mixing of warm air rising into cooler air above.
- ❖ Conditions favoring a temperature inversion include clear skies and calm winds when the sun begins to set.
- ❖ Generally form in the evening hours and last until after the sun comes up in the morning and starts to warm the air near the soil surface.
- ❖ Temperature inversions occur a majority of nights in June unless windy conditions prevail through the night.



Fog Settling in a Low Area



Smoke Movement During an Inversion





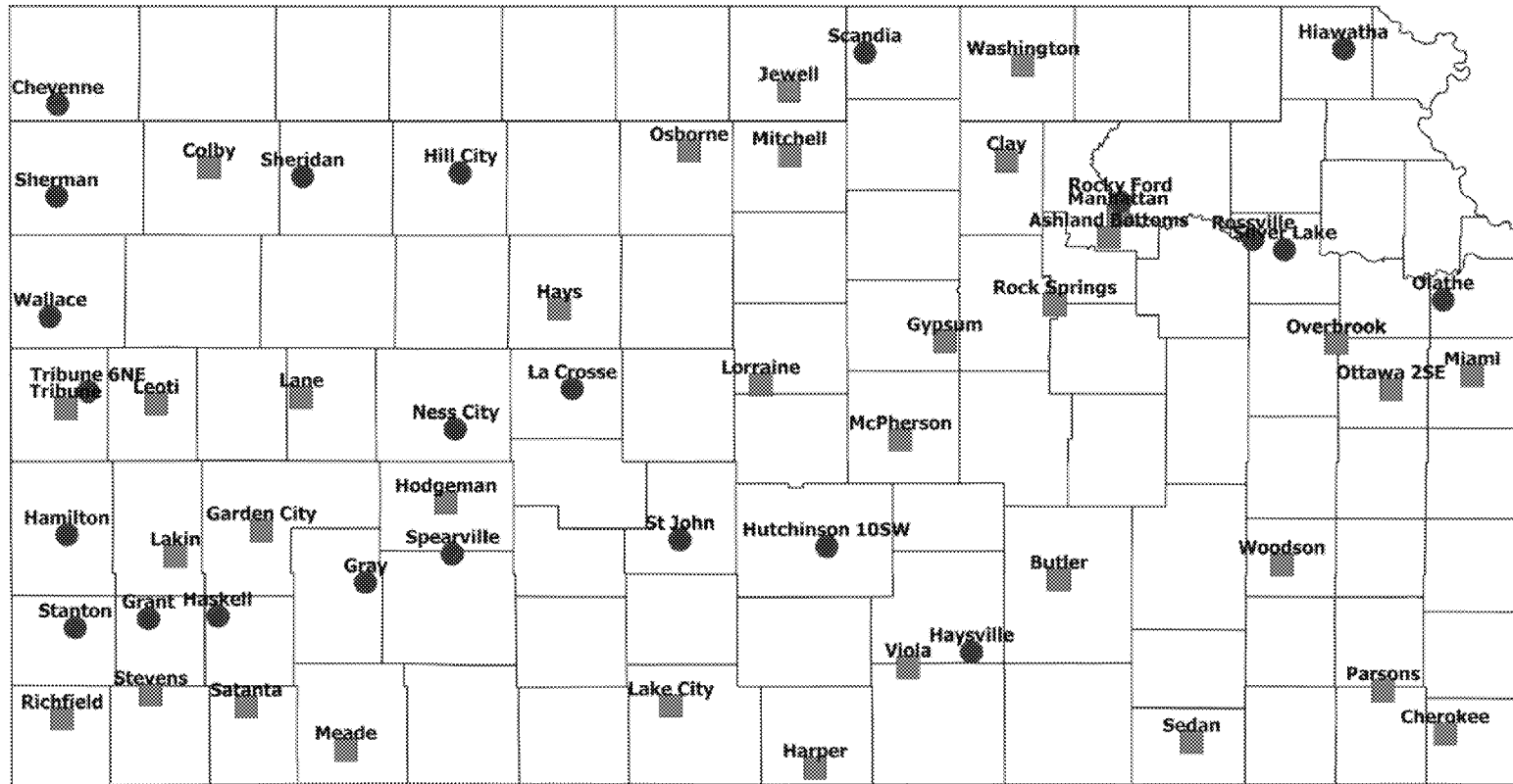
KANSAS STATE
UNIVERSITY

**Kansas
Mesonet**

Understanding Temperature Inversions and the Kansas Mesonet
Inversion Monitor Webpage

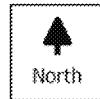
Chip Redmond - Mesonet Manager
Mary Knapp - Assistant Climatologist

2017 K-State Kansas Mesonet (9/26/17)



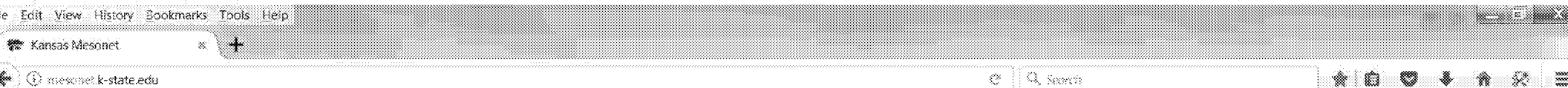
Station Type
 ● 10ft Tripod
 ■ 30' Tower

0 50 100 miles



Kansas State University Weather Data Library (WDL) Weather Station Mesonet
 As of: 9/26/17
 Created by: Christopher Redmond - WDL Manager
 christopherredmond@k-state.edu
 785-532-3029/785-477-6204
 mesonet.k-state.edu

<http://mesonet.k-state.edu/>



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Kansas Mesonet

New to the Mesonet: measuring temperature inversions

Track Freezing Temperatures with the Mesonet Freeze Monitor

Ashland Bottoms	
Station Metadata	
Temperature	71 °F
Dewpoint	36 °F
Humidity	28%
24-hr Precip	0 inches
Wind	SSE at 9 mph
SLP	1023.6 mb
Last Observed	4:20 PM CDT

Tonight



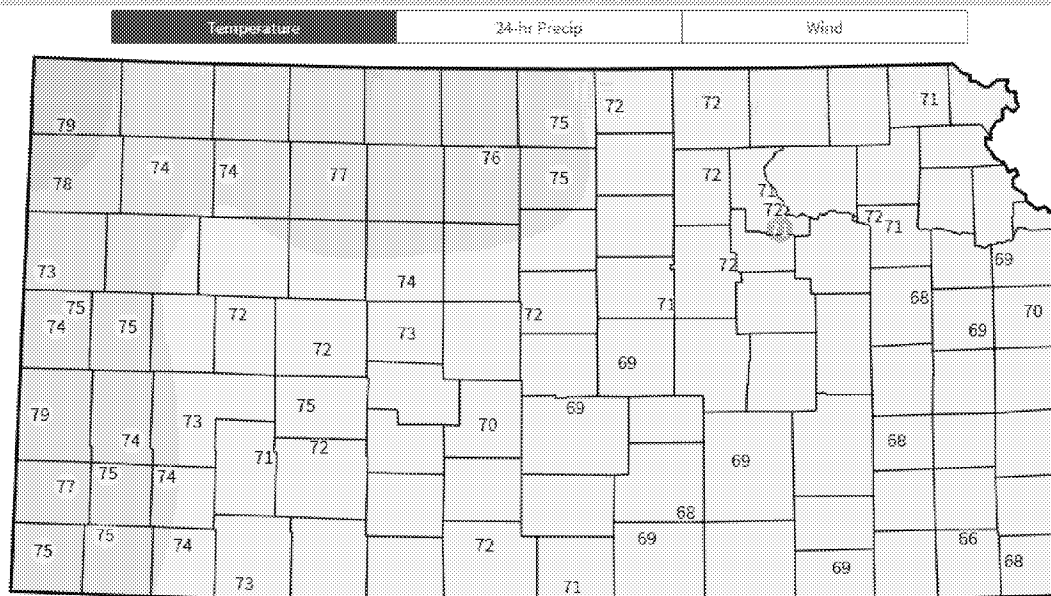
Mostly Clear

Tomorrow

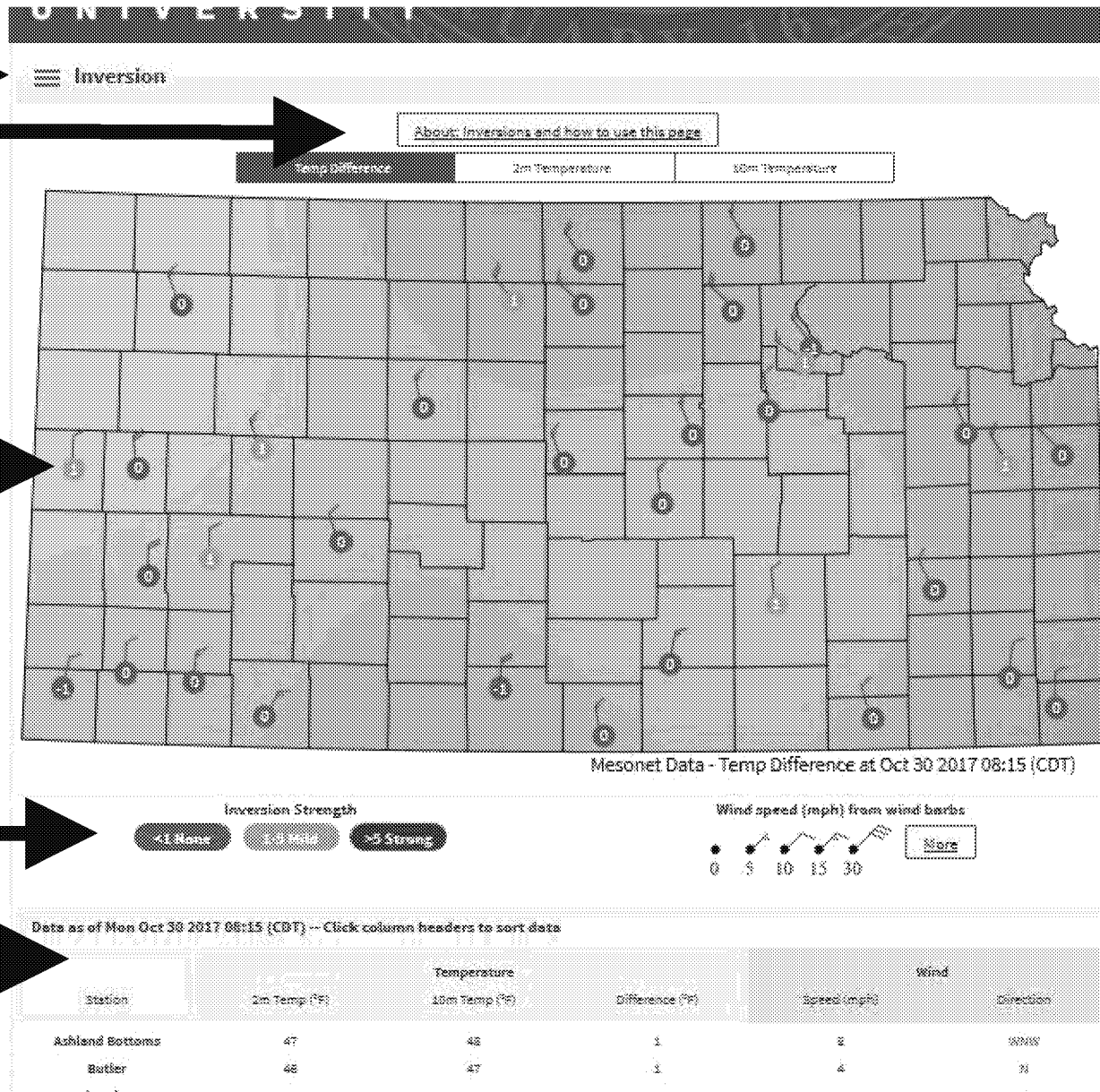


High 76 °F
Sunny

forecast provided by NOAA.



Navigate
Educate

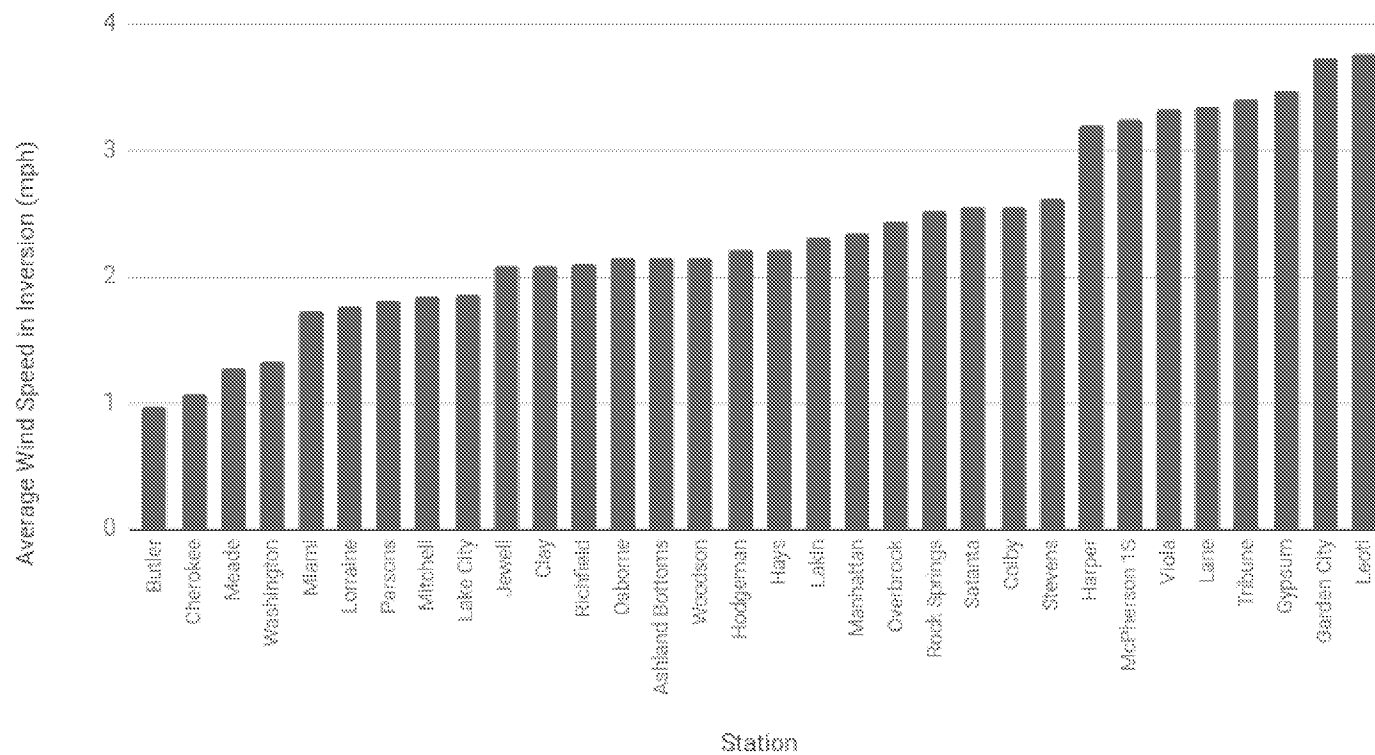


Disseminate

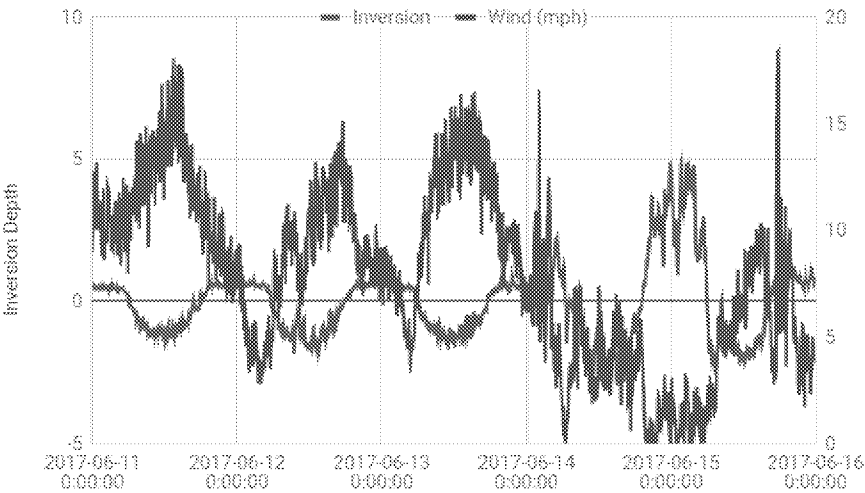
Interpret

Download

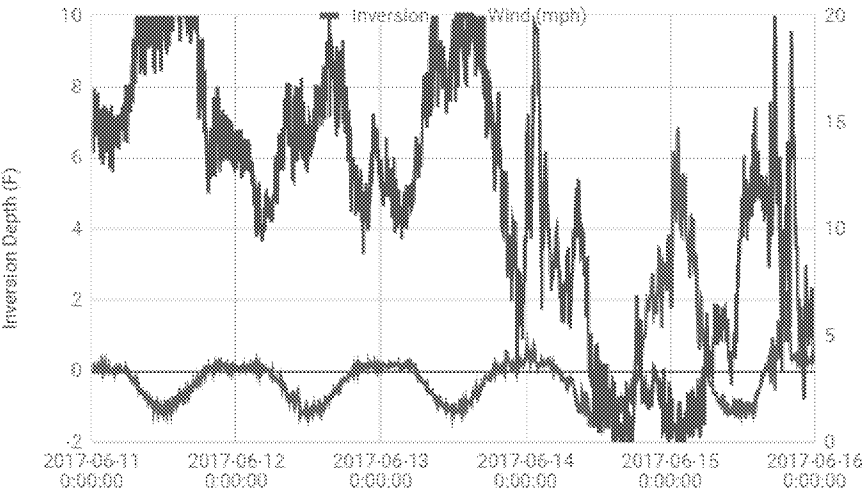
Sustained winds under an inversion



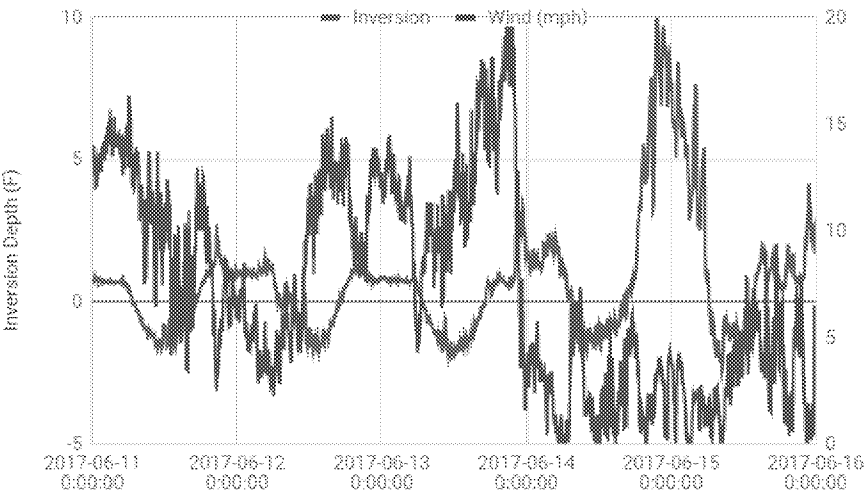
Manhattan, 6/13/17



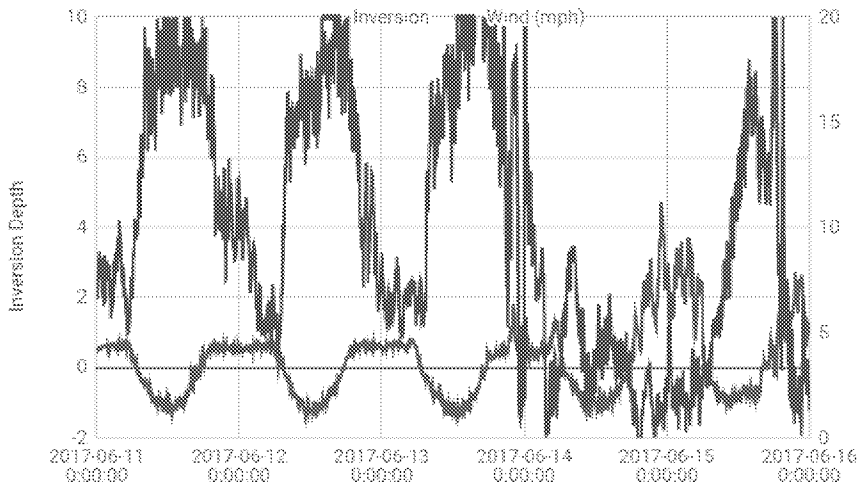
McPherson 1S, 6/13/17



Mitchell, 6/13/17



Lake City, 6/13/17

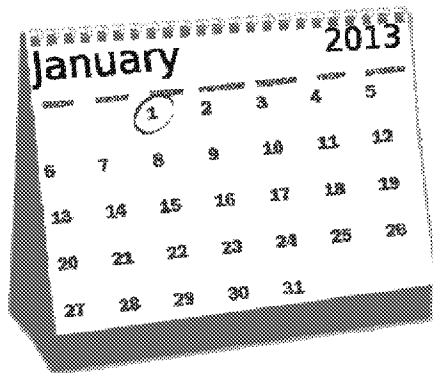


140 Days between June 1st - Oct 18

**On average,
118 days
had an
inversion**

**Statewide,
the mesonet
averaged 22
days of 5F+**

**Each station
averaged 2
days with 9F+
inversions**



Possible Solutions to Off-Target Dicamba

- ❖ Everybody plant Xtend soybeans?
- ❖ Follow label guidelines
- ❖ New label guidelines
- ❖ Cut-off dates?
- ❖ Awareness of surrounding crops
- ❖ Awareness of conditions
- ❖ Judicious decisions!

Farmer Allegedly Killed Over Dicamba

Confrontation Over Herbicide Drift Leads to Arkansas Shooting Death

Chris Clayton, DTN Ag Policy Editor
10/28/2016 | 5:09 PM CDT



Soybeans were one of several crops allegedly damaged this summer when farmers sprayed herbicide products containing dicamba. (Courtesy photo)

OMAHA (DTN) -- A northeast Arkansas cotton, soybean and corn farmer was allegedly shot to death Thursday afternoon in an argument over dicamba herbicide drift.

Mississippi County, Arkansas, Sheriff Dale Cook told DTN on Friday that the shooting of 55-year-old farmer Mike Wallace of Monette, Arkansas, was allegedly due to a physical confrontation that escalated regarding the spraying of dicamba.

Allan Curtis Jones, 26, of Arbyrd, Missouri, is in custody on first degree murder charges, but was released from jail on bond. He faces a court appearance on Tuesday in Arkansas.

Arbyrd is in the Missouri Bootheel just about five miles from where the shooting occurred. Cook told DTN that Jones was a farm manager for another farmer in the area. DTN could not find contact information to reach Jones for comment.

Wallace farmed about 5,000 acres of corn, cotton and soybeans. He was quoted in a Wall Street Journal article in early August expressing concern that as much as 40% of his soybean fields had been damaged by dicamba drift and he had filed a complaint over the situation with Arkansas officials, the WSJ reported. <http://dld.bz/...>

Dallas Peterson

Extension Weed Specialist

Department of Agronomy

dpeterso@ksu.edu

785-532-5776

Twitter: [@ksuweeddoc](https://twitter.com/ksuweeddoc)